M/035/002

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November 12, 2001

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Subject: Transmittal of Section 4.0 of the Revised 1998 Update of the Reclamation Plan for DOGM Permit# M/035/002 and the June 2000 Bingham Canyon Mine Water Management Plan for Groundwater Discharge Permit # UGW350010

Dear Sirs:

As described in the letter dated October 24, 2001 from Kennecott Utah Copper Corporation (Kennecott) to the Division of Oil, Gas and Mining (DOGM) and the Division of Water Quality (DWQ), Kennecott is providing several documents relating to the combined 1998 Update of the Reclamation Plan for DOGM Permit # M/035/002 and the June 2000 Bingham Canyon Mine Water Management Plan for Groundwater Discharge Permit # UGW350010. The combined plan will be titled "Bingham Canyon Mine 2002 Reclamation and Water Management Plan".

Attached are the following documents:

1) A detailed outline of the combined Bingham Canyon Mine Reclamation and Water Management Plan.
2) Detailed written responses to the DOGM and DWQ comments listed in your letter dated February 9, 2001.
3) Redlined text of the revised section 4.0 - Mine Waste Rock Disposal Area.

Kennecott will provide the remaining sections of the document to DOGM and DWQ no later than February 12, 2002. If you have any questions or comments about this submittal, please give me a call at 569-7553 or Rich Borden at 569-7141.

Sincerely,

William J. Adams

William J. Adams; Ph.D.
Director, Environmental Affairs

Cc: Doug Bacon, DERR

Bcc: Paula Doughty
Rich Borden
Brian Vinton
Bill Williams
File: OPS-RR-MF-Closure Plan

BINGHAM CANYON MINE 2002 RECLAMATION AND WATER MANAGEMENT PLAN OUTLINE

(Outline may be modified during document production)

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4.0 MINE WASTE DISPOSAL AREA

The mine waste rock disposal area currently covers about ~~5080~~ 5000 unreclaimed acres and contains approximately 3.5 billion tons of material. An additional ~~600~~ 410 acres at the foot of the Eastside dumps have already been reclaimed. About 250 acres surrounding the disposal areas are being used to manage leach water drain-down and meteoric water flows that have contacted the waste rock. A list of the support facilities associated with the disposal areas and water management systems is provided in Table 2-2. The large angle-of-repose (35 to 37 degrees) slopes on the eastern margins of the waste disposal areas are the most prominent visual features from the Salt Lake Valley, but they actually cover less than ~~forty~~ 15 percent of the total disturbed area. The highest inactive slope is 1200 feet high, but currently no active slopes are higher than 500 feet. Most of the disposal area is composed of flat to slightly irregular waste rock surfaces and angle of repose slopes that are less than 150 feet tall.

Future mine plans call for the placement of nearly one billion additional tons of waste rock before mine closure. The majority of this material will be placed in Bingham Canyon or in lifts on top of existing disposal areas. In some areas waste rock will have to be placed on previously unimpacted ground, so the total area impacted by disposal activities may increase by approximately 200 acres before closure. The additional disturbed acreage will be within the boundaries of DOGM permit number M/035/002 and will not exceed the 8000 acre area allocated for waste rock disposal in the 1978 Mining and Reclamation Plan. The impacted acreage could also increase during reclamation activities when angle of repose slopes are reduced, thereby increasing the waste rock footprint in some areas.

Mine waste is composed of a mixture of intrusive rocks, quartzite, limestone and limestone skarn. Except for copper, average metals concentrations are relatively low, as illustrated from a 66-sample average for the following elements: arsenic 31 mg/kg, barium 70 mg/kg, cadmium 2.0 mg/kg, chromium 55 mg/kg, copper 809 mg/kg, lead 380 mg/kg, selenium 2.6 mg/kg and zinc 311 mg/kg. The average sulfide concentration, predominantly pyrite, in unweathered waste rock from the pit is about three ~~four~~ percent, but sulfides are generally less abundant in waste rock exposed on the surface of the disposal areas. ~~only contains an average of one percent unoxidized sulfides.~~ The pyrite begins to oxidize immediately after the waste rock is placed, causing a decline in sulfide abundance and a release of sulfate, iron and acidity. Soils forming on the waste rock surface have paste pH values between 2 and 8; and paste conductivities, a measure of soil salinity, of between 20 and 9000 umhos/cm. Figure 4-1 is a map of the waste rock disposal areas showing the distribution of soil pH and salinity characteristics. The primary controls on soil pH are the percentage of sulfides in the waste rock, the percentage of limestone in the waste rock and the age of the waste rock surface on which the soil is forming. The primary controls on soil conductivity are the percentage of sulfides in the rock and the age of the waste rock surface. In general, the older the waste rock surface, the lower the pH, ~~and~~ the lower the conductivity, and the fewer sulfide minerals that are present. On the oldest surfaces with little intact pyrite, flushing of the soil by precipitation will eventually create a soil with a pH above 5 and low salinity. The geochemistry of the waste rock soils is described in detail in the paper "Geochemical evolution of sulphide-bearing waste rock soils at the Bingham Canyon Mine, Utah (Borden 2001). This paper is attached in Appendix D.

~~In some areas, thin vegetation has voluntarily established itself on waste rock surfaces with pH values above about 4.5 and conductivities below about 400 umhos/cm.~~ Volunteer vegetation is becoming established on almost all dump surfaces that have favorable soil chemistry. Botanical surveys were conducted on the waste rock disposal areas in 1999 and 2001. Ninety-one sites with various soil pH and salinity conditions were visited during these surveys and species counts and estimates of total vegetation cover were made at each site. Waste rock surfaces where any historic reclamation activities had occurred were excluded from the survey. As shown on Figures 4-2 through 4-5, vegetation has become established on most sites with soil pH above 4.5 and with conductivity below 1000 umhos/cm. Below a pH of 4.5 the toxicity of soluble aluminum and manganese becomes significant in most soils and will inhibit plant growth (Tucker et al. 1987). Vegetation density and diversity is highest on surfaces that have a soil pH above 6 and a conductivity of less than 500 umhos/cm. Below a pH of 6, nitrogen and phosphorus availability begins to decline in most soils (Tucker et al. 1987). The average volunteer vegetation cover for the 16 survey sites with a pH above 6 and conductivity below 500 umhos/cm is 36% and the average number of species observed was 13. Waste rock surfaces that had favorable soil chemistry but which do not support abundant vegetation generally have clear physical barriers to plant establishment. These physical barriers include strongly compacted surfaces, steep slopes with surface creep or lack of fine-grained material on the waste rock surface. Table 4-1 lists the most common species observed volunteering on the waste rock surfaces. The waste rock surfaces where soil chemistry is favorable for the establishment of native vegetation cover about 700 acres. There are approximately 200 additional acres where the soil pH is low, but which have very low salinity and very few intact sulfides. These sites are considered marginally favorable for vegetation establishment. ~~These favorable areas cover about 700 acres or 15 percent of the waste rock disposal area.~~ This combined 900-acre area is shown in green on Figure 4-1. ~~They~~ These surfaces ~~areas~~ are generally located on the south and southeast sides of the pit, and at higher elevations on the Eastside disposal area. Most of these sites are located above 6800 feet above sea level and are ten to more than fifty years old. Waste rock that was deposited in these areas was generally mined from higher, less mineralized and more weathered benches in the pit.

~~A long-term average of about 20,000 gpm of leach water is continuously recirculated between the Precipitation Plant and the waste rock disposal areas for copper recovery.~~ Groundwater and precipitation that contacts the waste rock generally becomes acidified (becoming ARD). For approximately 50 years, acidic leach water was also continuously recirculated between the Precipitation Plant and the waste rock disposal areas in order to recover copper. However, in 1999 leach water application rates began to be reduced and all leach water applications were terminated in September 2000. Between 1999 and the summer of 2001, flows from the base of the disposal areas in Bingham Canyon and on the east side of the Oquirrh Mountains have decreased from more than 25,000 gpm to less than 2000 gpm. Meteoric water that contacts the waste rock and leach water drain-down is captured by a series of State-permitted cutoff walls, sumps, drains, basins and pipes at the foot of the waste rock disposal areas. ~~Groundwater and precipitation that infiltrate the disposal areas is acidified (becoming ARD) and reports to the down gradient water collection systems.~~ These flows are currently routed to the concentrator process water circuit. ~~It is estimated that without leaching operations, there would still be an ARD base flow of about 1000 gpm emanating from the disposal areas. This ARD typically has a pH of less~~

Figure 4-2 Percent Vegetation Cover versus Soil Paste pH (excluding samples with conductivity >1000 umhos/cm)

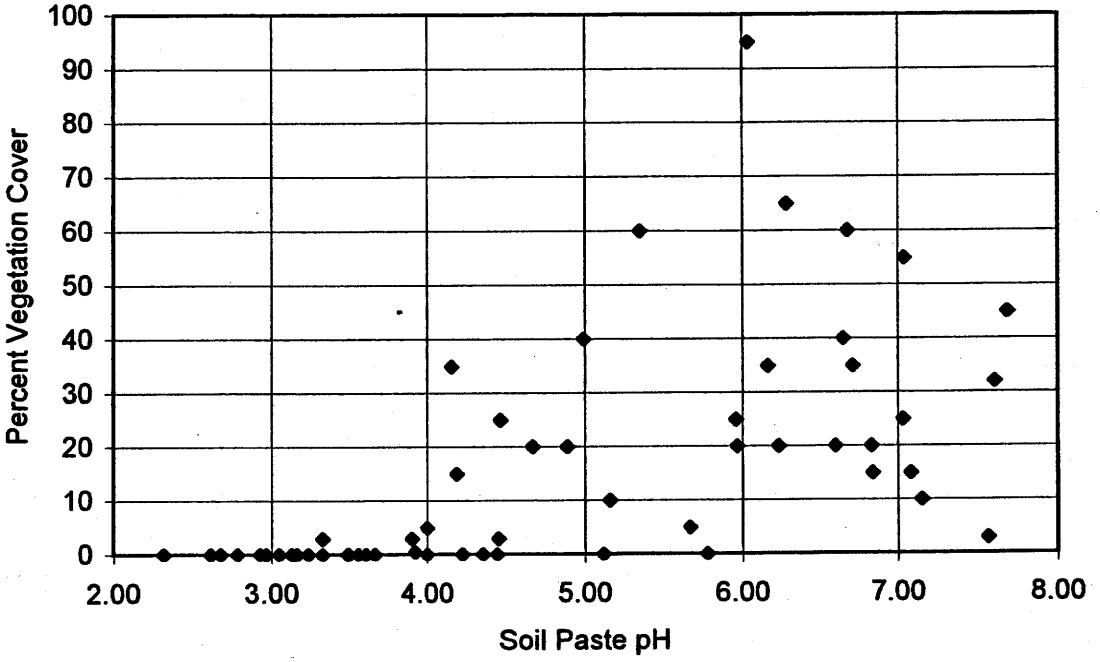


Figure 4-3 Number of Species Identified versus Soil Paste pH (excluding samples with conductivity >1000 umhos/cm)

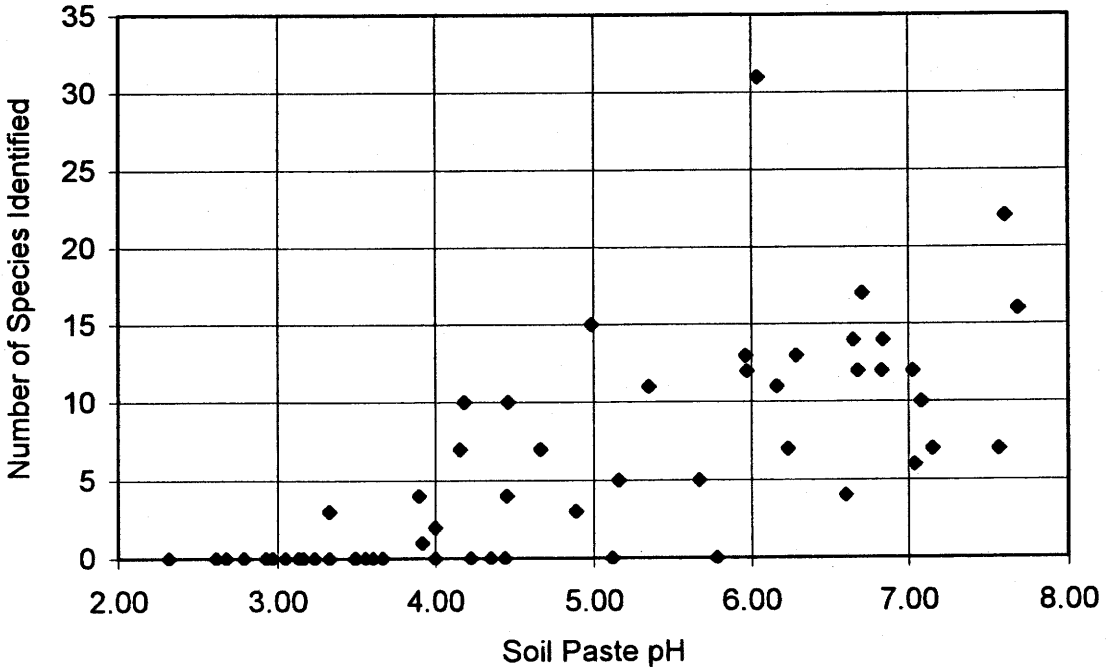


Figure 4-4 Percent Vegetation Cover versus Soil Paste Conductivity (excluding samples with pH <4.5)

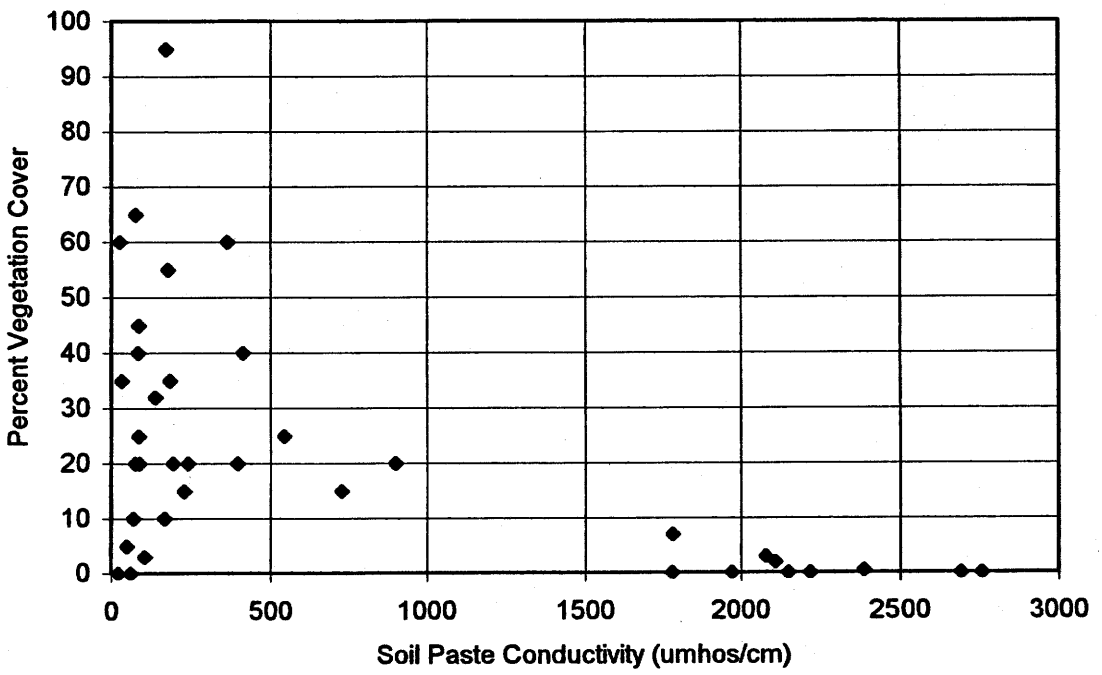
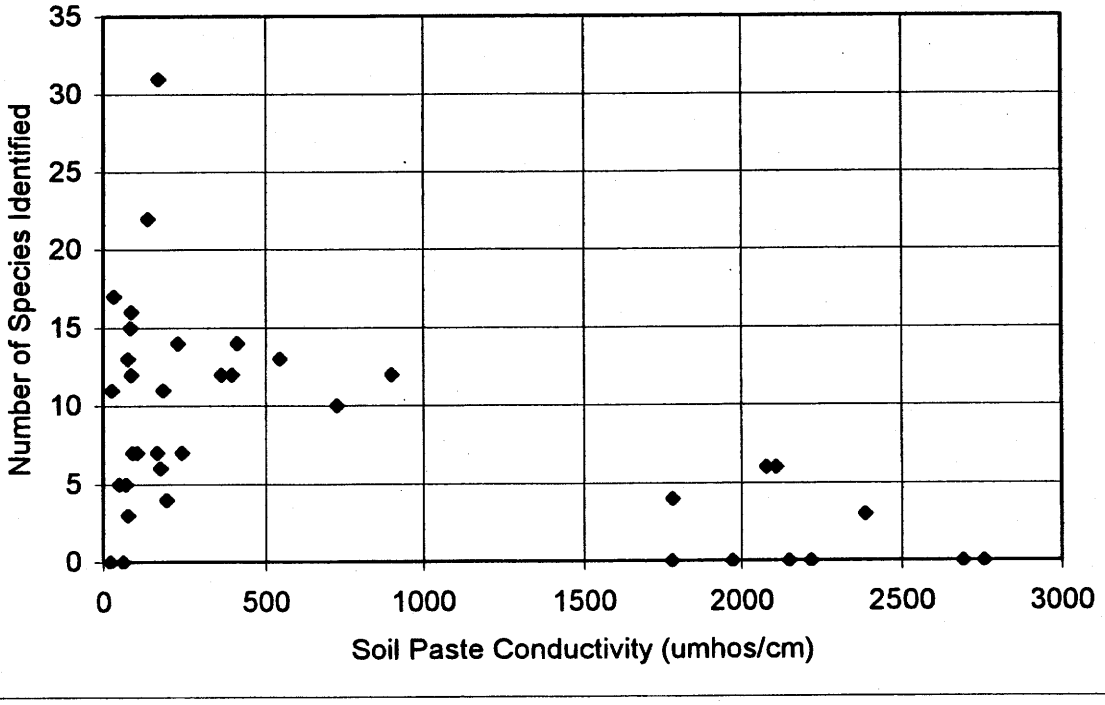


Figure 4-5 Number of Species Identified versus Soil Paste Conductivity (excluding samples with pH <4.5)



Common Name (1)	Scientific Name	% of Vegetated Sites Where Observed	% of Vegetated Sites Where Dominant (2)
Grasses			
Kentucky Bluegrass	Poa pratensis	33%	3%
Bottlebrush Squirreltail	Sitaniion hystrix	21%	0%
Sedge Species	Carex Species	15%	0%
Bluebunch Wheatgrass	Agropyron spicatum	10%	3%
Sheep Fescue	Festuca ovina	10%	3%
Mountain Brome	Bromus carinatus	8%	0%
Smooth Brome	Bromus inermis	8%	3%
Forbs			
Milfoil Yarrow	Achillea millifolium	54%	0%
Whitestem Blazingstar	Mentzelia albicaulis	44%	5%
Douglas' Dusty-maiden	Chaenactis douglasii	44%	3%
Ballhead Waterleaf	Hydrophyllum capitatum	41%	10%
Wasatch Penstemon	Penstemon cyananthus	33%	3%
Sulfur Buckwheat	Eriogonum umbellatum	13%	5%
Goldenrod Species	Solidago Species	13%	0%
Rydbergs Sweetpea	Lathyrus brachycalyx	10%	3%
Aster Species	Aster Species	10%	5%
Common Paintbrush	Castilleja chromosa	8%	0%
Silverleaf Lupine	Lupinus argentus	8%	5%
White Sweet Clover	Melilotus alba	8%	3%
Scarlet Gilia	Gilia aggregata	8%	3%
Trees and Shrubs			
Rubber Rabbitbrush	Chrysothamnus nauseosus	51%	36%
Big Sagebrush	Artemisia tridentata	33%	5%
Curl Leaf Mountain Mahogany	Cercocarpus ledifolius	18%	12%
Douglas Fir	Pseudotsuga menziesii	13%	5%
Bigtooth Maple	Acer grandidentatum	10%	0%
Chokecherry	Prunus virginiana	8%	0%
Oakbrush Sumak	Rhus trilobata	8%	0%
Quaking Aspen	Populus tremuloides	5%	3%
Weedy Species (3)			
Yellow Toadflax	Linaria vulgaris	69%	33%
Woolly Mullein	Verbascum thapsus	46%	3%
Cheatgrass	Bromus tectorum	33%	9%
Canada Thistle	Cirsuim arvense	28%	3%

(1) Grass, forb, tree and shrub species are listed if they were identified at 3 or more sites or if they were the dominant species at 1 or more sites.

(2) At each site between 0 and 4 species were identified as being the dominant species at the site.

(3) These species are listed as invasive noxious weeds in the United States Geological Survey Southwest Exotic Mapping Program (covering Utah, Colorado, Arizona and New Mexico). For soils with pH >7 and conductivity <500 the only dominant weedy species observed at any site was yellow toadflax.

Table 4-1 Most Common Species Volunteering on the Bingham Canyon Waste Rock Disposal Areas

~~than 4.0 and TDS concentrations of greater than 10,000 mg/L. Meteoric waters that run off the surface of the waste rock disposal areas are also captured by the down gradient water collection systems. This contact meteoric water typically has pH values between 4.0 and 7.0, and TDS concentrations between 1500 and 10,000 mg/L. The average flow of this water is estimated to be 1200 gpm. Non contact water is surface runoff and groundwater flow that has not come into contact with sulfide bearing rock. This water is currently captured on the up gradient side of the waste rock disposal areas and the Bingham Pit. It typically has TDS concentrations of less than 1000 mg/L and near neutral pHs. Current flows range from a high of 30,000 gpm during peak runoff events to a baseline flow of about 1000 gpm, exclusive of pit dewatering. All of these flows, except for water in the leach circuit, are currently routed to the concentrator process water circuit.~~ During peak runoff periods, excess water is temporarily stored in the Large Bingham Reservoir. Anticipated post closure flows associated with the waste rock disposal areas are discussed in Section 10.0.

Severe erosional events and failures have occurred on various waste rock slopes in the past. Since the termination of active dumping on the high slopes facing the Salt Lake Valley in 1984 the frequency and magnitude of slope failures have decreased significantly. However, several shallow surface slumps and debris flows have occurred in the past decade. Precipitation greater than the 25 year, 24-hour storm event (the minimum system requirements specified by the storm water regulations) that falls on the slopes may also exceed the capacity of the some down-gradient storm water and sediment collection systems. In such cases, contaminated water and sediment ~~may~~ has the potential to escape KUCC property. Severe erosional events also fill the water collection systems with sediment increasing the frequency and cost of maintenance. In the past decade these events have most commonly occurred on the waste rock disposal areas above Butterfield Creek on the southeast side of the pit. In only two cases has contaminated sediment or water escaped the property since the Eastside Collection System was upgraded between 1993 and 1996.

4.1 CLOSURE ISSUES

The original Mining and Reclamation Plan submitted to DOGM in 1976 specified the following activities for the mine waste disposal area at closure:

- all dumps will be left in a safe and stable condition
- collection systems will be provided to contain natural seepage in the area
- dikes and ponds will be constructed on the upper levels of the dumps to prevent slope wash and possible mud slides
- no major revegetation is planned because the majority of the waste material contains natural sulfide mineralization

- if and when revegetation practices or methods are developed which would make vegetation economically practicable, such practices and methods will be employed on the dumps

- when no longer needed in mining, mineral extraction or subsequent operations, surface facilities including buildings, above ground utilities, railroads, piping and equipment will be removed.

Current permits and regulations require KUCC to control contact water flows from the waste rock disposal areas in order to protect surface and groundwater quality. The goal of these regulations is to prevent any unpermitted discharge of contaminated water or sediment from the property. Groundwater Discharge Permit number UGW350010 also requires that KUCC take steps to minimize the infiltration of meteoric water into the waste rock. After closure, KUCC will continue to maintain the existing groundwater and surface water collection systems at the foot of the disposal areas to comply with all applicable requirements. In order to insure compliance after closure in the most cost effective manner, the following goals must be considered during closure planning:

- insure that catastrophic events cannot compromise the water collection systems or transport contaminated water and sediment off KUCC property

- reduce long-term ARD generation from the disposal areas to minimize the risk of down-gradient groundwater contamination and long-term water handling and treatment costs

- minimize the loading of sediment and debris from the disposal areas to reduce long-term maintenance costs for the water collection systems.

~~Other requirements that will probably remain in place after closure are the continued recovery of contaminated water from beneath the Dry Fork waste rock disposal area and from the Bingham Creek groundwater plume.~~

Potential physical hazards on the waste rock disposal areas will require that public access be restricted after closure. ~~Unless all slopes are reduced there will be steep and potentially unstable areas that pose hazards to the general public.~~ Slopes that are not reduced will be steep and covered with loose rock and could pose a hazard if accessed by the general public.

4.2 POSSIBLE POST-CLOSURE LAND USE

Based upon the requirement for long-term water management on and around the waste rock disposal areas, the acidic nature of the waste rock, and the public safety issues associated with steep slopes, post-mining land uses in these areas will, by necessity, be limited.

Whatever final closure scenario is ultimately selected, most of the waste rock disposal areas will likely be operated as a water management facility with limited public access. ~~Those parts of the~~

disposal area that have favorable soils, or where favorable soils have been created, may be revegetated to become wildlife habitat. Those parts of the disposal area that are revegetated will also become wildlife habitat.

4.3 RECLAMATION STRATEGY

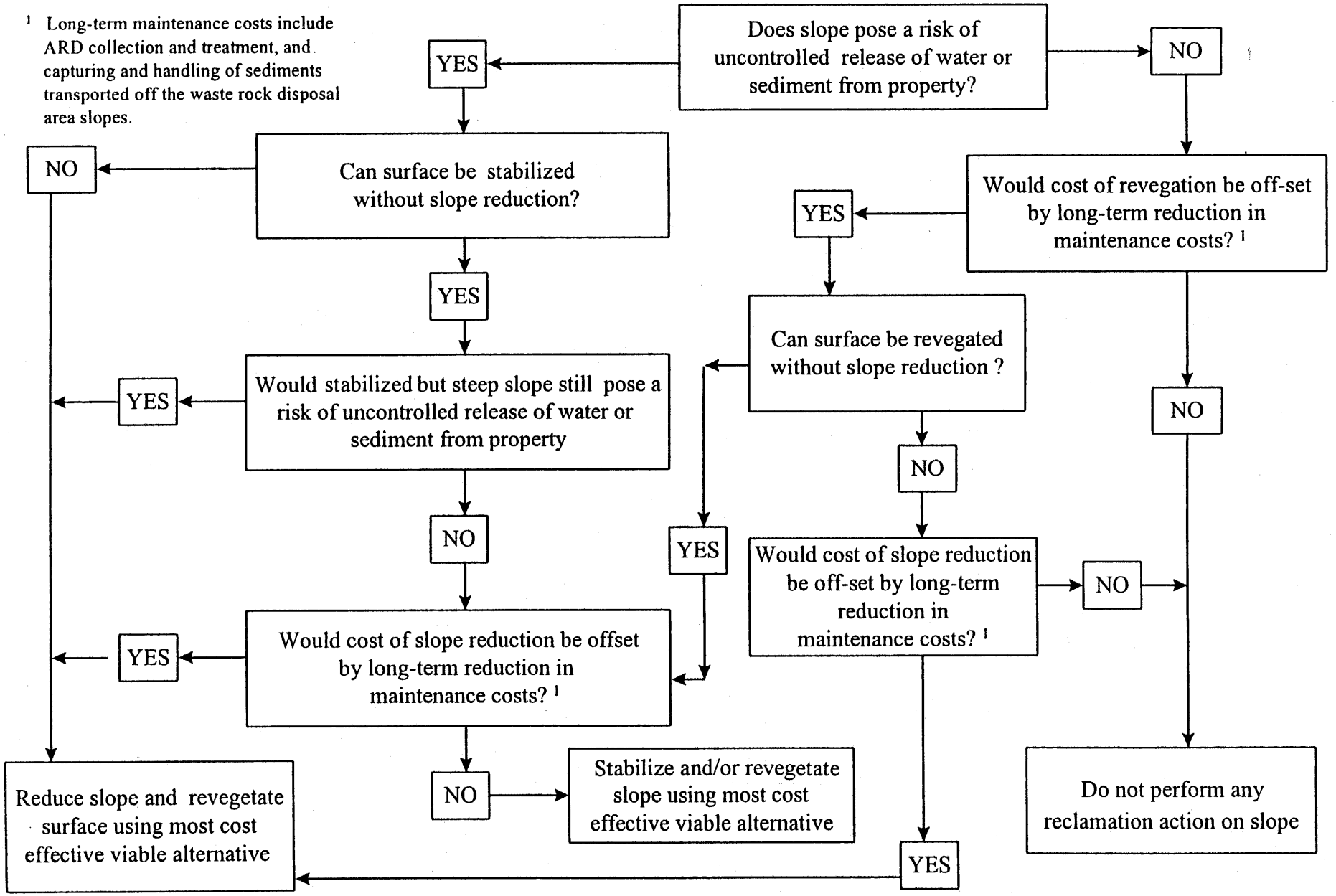
The reclamation strategy for the waste rock disposal areas will be has been designed to address the issues listed in Section 4.1 in the most environmentally responsible and cost effective manner. To comply with the 1976 Plan, all surface structures and debris in the area will have to be removed except for those with a post-closure use.

The existing groundwater, surface water and sediment collection systems at the base of the disposal areas will continue to operate after closure. Up gradient systems such as the clean water collection system in the Dry Fork drainage will also continue to operate after closure. Specific sections of both systems may be enlarged or modified if they are found to be incapable of handling recurring peak flow events or to require excessive amounts of maintenance. These post closure water management systems are discussed in detail in Section 10.0. In order to comply with the 1976 Plan, and to reduce ARD, run off, and sediment that must be handled by the down gradient system, selective reclamation of the overlying waste rock disposal areas will also be has also been considered.

Table 3 lists general reclamation options and specific techniques. The local site conditions at any given location on the disposal area surface will limit the reclamation techniques which are viable at that location. Parameters which may limit reclamation options include: soil chemistry, physical soil characteristics, slope angle, slope stability, slope orientation, elevation, geographic location, and surface and groundwater flow regimes. In general, the least costly reclamation technique that will still yield the desired result will be utilized at each location.

In compliance with the 1976 Plan, waste rock surfaces with favorable soil chemistry where revegetation is economically practicable will be reclaimed. On most other flat surfaces, the selection of reclamation alternatives will generally involved an analysis of reclamation costs versus potential downstream reductions in ARD that must be captured and treated. On higher waste rock slopes, this will require a more rigorous comparison of slope reclamation costs requirements with the probability of catastrophic events releasing contaminated materials from the property, potential reductions in peak runoff events, potential reductions in maintenance costs, and potential reductions in ARD that must be captured and treated is required. The relation between these issues is illustrated on Table 4-2. In theory, this approach will focus reclamation activities in areas where the greatest benefit can be derived at the least cost.

TABLE 4-2 FLOW CHART FOR DECISIONS ABOUT WASTE ROCK DISPOSAL AREA SLOPES



4.4 DATA REQUIREMENTS

In order to identify the final reclamation options for each portion of the waste rock disposal area, ~~design a cost-effective reclamation process for the waste rock disposal areas~~ the following data requirements will have to be filled:

- final geometry of the waste rock disposal areas, in particular the location and soil chemistry characteristics of future waste rock piles
- base ARD flows from various parts of the disposal area ~~(not including flows from the active leaching circuit)~~
- relative effects of each reclamation technique on infiltration and runoff
- ~~the soil chemistry limitations of each reclamation technique~~
- identification of new reclamation technologies which may become available between now and closure.

Many of these data requirements are being addressed by ongoing reclamation programs on the waste rock disposal areas and by the operation of pilot-scale water treatment facilities. Others such as the base flow of ARD from specific areas and the final geometry of the waste rock surface cannot be determined until some operations have been shut down.

4.5 ~~TENTATIVE~~ RECLAMATION ~~ACTIONS~~ ACTIVITIES

Tentative reclamation actions have been selected based upon the existing incomplete data set and on the assumption that the current mine plan adequately predicts the final geometry of the waste rock disposal area. Figure 4-6 is a map of the waste rock disposal area showing the reclamation actions that are currently planned. The actual acreage and boundaries of the various reclamation treatments may be modified in response to changes in the mine plan or other new information as it becomes available. Long-term water management plans on and adjacent to the waste rock disposal area are described in Section 10.0.

~~The conventional leaching circuit on the waste rock disposal area will be shut down as soon as it becomes uneconomical and after economical leach water disposal methods have been identified. Once the system has drained down, base flows of natural ARD from each part of the disposal area can be determined, and a long-term base flow database will be developed. This will allow one of the data gaps identified in Section 4.3 to be filled.~~

All surface debris, utilities and facilities without a post-closure use will be removed from the entire waste rock disposal area at closure. Reclamation of these facilities will be as described in Section 2.3. Based upon current assumption of post-mining use, the only facilities that may be left in place within the waste rock disposal area will be those related to long-term water

management such as the Large and Small Bingham Reservoirs, cutoff walls, sumps, drains, settling ponds, monitoring wells, utilities, selected roads and associated pipes and lined ditches. Public access will be controlled with a combination of engineering and institutional controls. Roads without a post-mining use will be blocked off, and fences and signs will be erected. Additional reclamation activities planned for selected portions of the waste rock dumps are described in the following sections.

~~The surface and groundwater collection systems up gradient and down gradient from the disposal areas will continue to be operated in perpetuity after closure. Additional wells and surface diversion structures may also be sited up gradient from disposal areas if justified by the quality and quantity of water that can be diverted. Waters that cannot be sold or discharged without treatment will be treated at a facility located adjacent to the Large Bingham Reservoir. It is currently assumed that a lime treatment plant with clarifiers and sludge densification facilities will be used, but other more economical technologies may be identified in the future. This facility will be designed to handle the following estimated flows: 1000 gpm of ARD, 1200 gpm of contact meteoric water, 250 gpm from the acidic groundwater plume beneath the Dry Fork disposal area, and 250 gpm of acidic groundwater from the core of the Bingham Creek plume. The estimated 1700 gpm that will discharge from the pit will also be treated at this facility if the Conveyor Tunnel is used (Section 3.5).~~

~~All flat waste rock surfaces will be bermed and contoured so runoff is diverted away from steep slopes. Water collection systems will be installed on selected surfaces which are large enough, and from which water can be cost-effectively conveyed to existing water collection facilities. Unstable slopes that pose a risk to the down gradient water collection facilities and that cannot be stabilized by revegetation or another method may be reduced in slope to no steeper than 2.5 horizontal to 1.0 vertical. Selected dump surfaces with favorable soils will be seeded or planted with tree and shrub seedlings with little or no soil modification. Up to 700 acres may be suitable for direct planting. Other suitable dump surfaces may be reclaimed after the soil chemistry has been adjusted by the addition of neutralizing materials, passivation products and/or biosolids. Where required, or where justified by a cost/benefit analysis, acidic surfaces may be capped with suitable materials and revegetated.~~

4.5.1 Completed Reclamation Activities

Reclamation work has already been completed on about 410 acres of the waste rock disposal area. The sites that have been reclaimed are located on the northeast portion of the disposal area and in drainages along the eastern edge of the disposal area (Figure 4-6). It should be noted that this acreage estimate only includes areas that were directly impacted by Bingham Canyon Mine waste rock disposal. It does not include several hundred additional acres that have also been reclaimed within the DOGM permit boundaries, but that were impacted by historic leach water contact or by other historic mining operations unrelated to open pit mining at Bingham Canyon.

Waste rock has been removed from about 80 acres within drainages below the Eastside disposal area. Some of this waste rock was transported into the drainages by erosion caused by the historic leaching operations and some was intentionally placed in the drainages to create dams and

settling ponds for the historic leach collection system. All of this waste rock was moved back to the foot of the waste rock disposal areas and the drainage surfaces were recontoured and revegetated.

About 330 acres on the northeast margin of the Eastside disposal area were recontoured, capped and revegetated. The angle of repose slopes were reduced to slopes of 2.5:1 or less and between 18 and 48 inches of growth media were placed on top of the waste rock before the surfaces were revegetated.

4.5.2 Areas to be Recontoured and Revegetated

Approximately 900 acres of the waste rock surface are currently planned to be recontoured and revegetated. Most of the areas that are intended to be revegetated are located above 6800 feet on the southwest, south and east sides of the pit (Figure 4-6). All of these sites are underlain by waste rock soils that will support vegetation after relatively minor soil modification. The waste rock soils in these areas contain very few intact sulfide minerals, generally have salinities that are less than 500 umhos/cm and have pH values between 2.5 and 8.

The anticipated benefits of the recontouring and revegetation activities will be:

- To reduce infiltration into these waste rock surfaces by enhancing evapotranpiration. This will reduce the amount of waste rock contact water that must be collected and treated at the toe of the disposal area and that may reach the regional water table (Section 10.0).
- To provide wildlife habitat.
- To provide a native seed source for surrounding waste rock surfaces that currently cannot support vegetation but that may be able to after additional weathering.
- To enhance slope stability and limit erosion.
- To create a surface that resembles the surrounding natural landforms.

Most angle of repose slopes will be reduced to 2.5:1 or less, depressions in the surface will be filled, end dump piles will be smoothed out and compacted surfaces will be ripped. Surfaces will be recontoured to minimize the transport of runoff from large relatively flat surfaces to adjacent slopes. Wherever possible, native mature volunteer vegetation on the dump surface will be left undisturbed during these recontouring activities. This will enhance surface stability and will supply a native seed source to the surrounding recontoured waste rock surface. The recontouring will also be designed to limit the amount of previously unimpacted land that is disturbed. Many of these waste rock disposal surfaces surround small islands of native hillside that can also provide a valuable seed and mycorrhizae source to the surrounding waste rock surface. In some locations angle of repose slopes will be left in place if they already support native vegetation or if the

recontouring will cover important unimpacted areas below them. It is anticipated that the recontouring and ripping will remove most physical barriers to vegetation establishment. Angle of repose slopes will be reduced to a more stable angle, and heavily compacted surfaces will be loosened by ripping.

The pH of acidic surfaces will be raised above 6 by the addition of crushed limestone or another neutralizing agent that does not inhibit plant growth. Because there are few intact acid-generating sulfides in the waste rock, these surfaces will not reacidify once the pH has been raised. Depending on the initial soil chemistry at each site, anywhere from 0 to 10 tons/acre of limestone will be applied to the surface. In general, no limestone will be added to surfaces that already have a pH above 7. All the surfaces will also receive a light application of chemical fertilizer to provide nitrogen, phosphorus and potassium (not to exceed 50 lbs/acre available nitrogen) or may receive biosolids at application rates not to exceed 10 tons/acre. In general, phosphorus application rates will be higher than nitrogen application rates, which will be higher than potassium application rates. Studies at Bingham Canyon and elsewhere indicate that over-fertilization with nitrogen in biosolids or chemical fertilizers promotes the establishment of weedy species and inhibits species succession (Rick Black in press, McLendon and Redente 1992).

A seed mix that is predominantly composed of native grasses, forbs, shrubs and trees will be broadcast or drill seeded onto the surface. The seed mixes that are used will largely be composed of native species that are already volunteering onto the waste rock surface (Table 4-1). However, the exact composition of the seed mixes will vary depending on elevation and slope aspect of the surface to be seeded, and on species availability and assessments of earlier revegetation efforts.

Most of these reclamation activities will occur between the present and mine closure.

4.5.3 Areas to be Recontoured

Approximately 2600 acres of the waste rock surface are currently planned to be recontoured without revegetation. This area includes flat and irregular surfaces as well as angle of repose slopes that are less than 150 feet high (Figure 4-6). These areas will not be revegetated because they currently contain abundant unweathered sulfides, have elevated soil salinity and generally have low pH. If limestone were applied to neutralize the acidity in these areas, continued sulfide oxidation would cause most surfaces to reacidify (Doolittle and Hossner 1997). Even if the surface pH could be maintained at near neutral, the salinity of these soils would prevent native vegetation establishment because they will continue to contain abundant gypsum precipitated during the in situ neutralization of acid generated from the oxidizing sulfides (Borden 2001). Water in contact with gypsum will maintain a conductivity of approximately 2000 umhos/cm, well above the salinity tolerance of most native species (Figures 4-4 and 4-5) (Richards 1954; Wali 1999).

The anticipated benefits of the recontouring activities will be:

- To reduce infiltration into these waste rock surfaces by reducing pooling on the surface. This will reduce the amount of waste rock contact water that must be collected and

treated at the toe of the disposal area and that may reach the regional water table (Section 10.0).

- To create a surface that resembles the surrounding natural landforms.

- To remove physical barriers to vegetation establishment such as steep slopes with surface creep and compacted surfaces. Continued weathering and sulfide oxidation on these surfaces will eventually create soils that are geochemically favorable to native vegetation establishment.

- To enhance slope stability.

Most angle of repose slopes that are less than 150 feet tall will be reduced to 2.5:1 or less, depressions in the surface will be filled and end dump piles will be smoothed out. Surfaces will be recontoured to minimize the transport of runoff from large relatively flat surfaces to adjacent slopes. Neutralizing agents such as cement kiln dust, waste lime or waste limestone may be applied to selected surfaces if they become available in the future and if they can be placed economically. Some relatively short angle of repose slopes may be left in place if the slope reduction would cover important facilities or previously unimpacted land.

These areas will generally be recontoured between the termination of waste rock production and one to two years after mine closure.

4.5.4 Areas to Undergo Slope Stabilization Study

A slope stabilization study is planned to be performed on approximately 200 acres located on the southeast margin of the waste rock disposal areas (Figure 4-6). This area covers the angle of repose slopes that are located at the upper end of six dry tributary drainages to Butterfield Creek, a perennial stream. The individual drainages are listed along with selected physical characteristics on Table 4-3. The maximum height of the angle of repose slopes in these drainages varies from approximately 700 to 900 feet and they are all less than a mile from Butterfield Creek. A preliminary assessment of these areas indicates that they have the greatest potential of any slopes to release contaminated sediment and contact water from the property. All six of the drainages are well-defined, narrow channels with generally thin alluvial deposits and relatively steep gradients. The gradients vary between 650 feet/mile and 990 feet/mile from the toe of the waste rock angle of repose slope to the drainage intersection with Butterfield Creek. Since the Eastside Collection System at the foot of the Eastside disposal area was upgraded between 1993 and 1996, there have only been two large incidents in which contaminated sediment or water have escaped the property. These incidents occurred in the Olsen and Castro drainages at the southern end of the 200-acre area. Sediments deposited down gradient during these incidents were cleaned up and returned to the waste rock disposal area.

The slope stabilization study will involve a detailed assessment of the risk of contaminated water and sediment release in each drainage. An assessment of long-term maintenance costs in each drainage with and without slope stabilization will also be made. The study will also involve an

Drainage (1)	Distance from Dump Toe to Butterfield Creek	Approximate Drainage Gradient (2)
Tributary Drainages to Butterfield		
Olsen	3500 ft	770 ft/mile
Butterfield	3500 ft	990 ft/mile
Castro	4500 ft	800 ft/mile
South Saints Rest	4000 ft	840 ft/mile
Saints Rest	3400 ft	780 ft/mile
Yosemite	5000 ft	650 ft/mile
Other Eastside Drainages		
Copper	Not a Tributary (3)	480 ft/mile
Keystone	Not a Tributary (3)	450 ft/mile
Bingham	Not a Tributary (3)	160 ft/mile
(1) These drainages all contain or will contain angle of repose waste rock slopes associated with the Eastside waste rock disposal area. None of these drainages contain perennial streams. The drainages are listed in order from south to north.		
(2) The gradient is expressed in terms of feet vertical drop per mile of drainage length. The gradient for the tributary drainages to Butterfield Creek is measured from the toe of the angle of repose waste rock slope to the intersection with Butterfield Creek. The gradient for the other drainages is measured from the toe of the angle of repose waste rock slope to a point one mile down the drainage.		
(3) These drainages ultimately intersect the Jordan River more than nine miles down gradient. The closest body of water is the Provo Reservoir Canal more than five miles down-gradient. The closest public access point is highway 111 more than a mile down gradient.		

Table 4-3 Physical Characteristics of Drainages below the Eastside Waste Rock Disposal Areas

engineering assessment of the cost and efficacy of various slope stabilization methods in each drainage. The study is planned for completion in the next two years and slope stabilization plans for each drainage will be created. It is anticipated that the angle of repose slopes in the Olsen, Butterfield, Castro, South Saints Rest and Saints Rest drainages will need to be reduced, capped with a growth media and revegetated unless another suitable stabilization alternative can be identified. The requirements for the slopes within the Yosemite drainage cannot be identified until the assessment is completed. This drainage generally poses a lesser risk of contaminant release because it has a lower gradient and has a longer travel distance to reach Butterfield Creek than the other drainages (Table 4-3).

4.5.5 Areas Requiring No Further Action

No further action is planned for approximately 1500 acres within the waste rock disposal area. These acres are entirely comprised of angle of repose slopes that are greater than 150 feet tall. The majority of these slopes are within Bingham Canyon, but this also includes the tall Eastside angle of repose slopes located north of the Butterfield Canyon tributary drainages, the angle of repose slopes in upper Dry Fork Canyon and Freeman Gulch, and miscellaneous slopes on top of the waste rock disposal area (Figure 4-6). As described earlier in this section, surface debris, utilities and facilities without a post-mining use will be removed from these slopes. The upper crest of the angle of repose slopes will also be bermed, and the overlying waste rock surfaces will be contoured, to prevent runoff from flowing onto the slopes.

None of these slopes pose a significant risk of contaminant transport off the property and the costs of slope stabilization would not be offset by the reductions in long-term maintenance costs for the sediment and water collection systems located down gradient from the slopes. All of these slopes are either located above relatively flat waste rock surfaces or are above relatively low gradient, poorly defined drainages. All of these slopes are also distant from any down-gradient public access points or water bodies (Table 4-3). These slopes are tall, so the cost per acre for slope reduction would be prohibitively high. All of these slopes are also composed of waste rock with abundant pyrite, high salinity and low pH, so revegetation would not be practicable.

Most of the slopes in Bingham Canyon will toe onto existing waste rock surfaces, so waste rock and sediment that accumulates at the toe of the slope will only impact preexisting waste rock disposal areas. Bingham Canyon itself is a broad, poorly defined, low gradient drainage that is floored with waste rock and alluvium, so the risk of significant down-canyon transport of waste rock material is minimal. The main angle of repose slope in Bingham Canyon will be more than a mile up gradient from the Bingham cutoff wall and the canyon floor drops by less than 200 feet/mile in this area.

About half of the east-facing angle of repose slopes where no further action is planned are located immediately above large, flat waste rock surfaces. Shallow failures or erosional events on these slopes will merely deposit material onto the lower waste rock surface. The remaining east-facing angle of repose slopes are located above broad, poorly defined, alluvium-floored and relatively low-gradient dry drainages (Copper and Keystone drainages on Table 4-3). The closest water body of any kind is the Provo Reservoir Canal more than five miles down gradient and the closest

public access point is Highway 111 more than one mile down gradient. The Jordan River is located more than nine miles down gradient.

The tall angle of repose slopes in upper Dry Fork Canyon and Freeman gulch are facing up-canyon, so the risk of significant up-gradient transport of sediment and water from these slopes is minimal. If these slopes were reduced it would also cover previously unimpacted, forested areas within these drainages.

SECTION 4.0 REFERENCES

Black, R., in press, Analysis of selected revegetation efforts at the Bingham Canyon Mine and Tailings Impoundment, Report for Kennecott Utah Copper.

Borden, R., 2001, Geochemical evolution of sulphide-bearing waste rock soils at the Bingham Canyon Mine, Utah, Geochemistry, Exploration, Environment and Analysis, v. 1, pp. 15-22.

Doolittle, J. J., and Hossner, L. R., 1997, Acid-base properties of a limed pyritic overburden during simulated weathering, Journal of Environmental Quality, v. 26, pp. 1655-1662.

McLendon, T. and Redente, E. F., 1992, Effects of nitrogen limitation on species replacement dynamics during early secondary succession on a semiarid sagebrush site, Oecologia, v. 91, pp. 312-317.

Richards, L. A., 1954, Diagnosis and improvement of saline soils and alkali soils, United States Department of Agriculture Handbook 60.

Tucker, G. B., Berg, W. A., and Gentz, D. H., 1987, pH, in Reclaiming mine soils and overburden in the western United States, Williams R. D. and Schuman G. E. eds, Soil Conservation Society of America, pp. 3-26.

United States Geological Survey, 2001, Southwest Exotic Mapping Program, http://usgs.nau.edu/swemp/Info.

Wali, M. K., 1999, Ecological succession and the rehabilitation of disturbed terrestrial ecosystems, Plant and Soil, v. 213, pp. 195-220.

KENNECOTT UTAH COPPER CORPORATION NOVEMBER 12, 2001 COMMENT RESPONSES TO:

DOGM & DWQ REVIEW COMMENTS ON THE

1998 UPDATE OF THE RECLAMATION PLAN AND MINE WATER MANAGEMENT PLAN, JUNE 2000 SUBMITTED BY KENNECOTT UTAH COPPER CORPORATION FOR THE BINGHAM CANYON MINE

NOTE: KUCC COMMENTS ARE SHOWN IN BOLD

NOTE: These comments are formatted according to the headings in the volume titled "1998 Update of the Reclamation Plan" (1998 Update). Headings from the original 1998 document which include comments are included for ease of reference. Comments in this review which were specific to the content of the 2000 Addendum document (Mine Water Management Plan, June 2000) are shown below in italicized print to assist your review.

1.3.1 NATIONAL HISTORICAL SITE REGISTRY

Please describe the precise area covered by the national historic registry listing. **Please provide**:

- the criteria which the Bingham Canyon Mine satisfied in order to be listed. **Please describe** reclamation limitations imposed by this listing and other restrictions for active mines listed on the registry. (AG) (-DWQ-)

Based on DOGM's review of information relating to the National Historic Preservation Act of 1966, owners of private property listed in the National Register are free to maintain, manage, or dispose of their property as they choose provided that no federal monies are involved. Based on this information, it would be incorrect to infer that listing on the National Register precludes any legal requirement under the Utah Mined Land Reclamation Act for KUCC to reclaim any portion of the privately owned Bingham Canyon Mine open pit area. (DJ, AG)

KUCC will provide additional information on the National Historic Registry listing including any limitations that the listing may place on activities within and around the pit.

1.3.5 CERCLA SITES AND NRDC FOR ACID PLUME

The submission stated other contaminated sites may be identified in the future and as such remediation will be required after closure. **Please provide**:

- a current list and map of the candidate sites for CERCLA listing. (TM)

As part of the Memorandum of Understanding between EPA, UDEQ and KUCC that was signed September 27, 1995, KUCC agreed to "Complete environmental assessments of currently identified on-site historic facilities and their associated wastes and conduct cleanups

of these wastes if shown necessary by the ecological and human health risk assessments." To date, the majority of sites that fall within DOGM permit boundaries have received a *No Further Action* status from EPA and UDEQ as identified in two separate Records of Decision dated December 13, 2000 and September 28, 2001. A list and map of south end historic mining sites will be added to the revised plan. The remainder of the sites on the north end of the property associated with the smelter and refinery are to be included in the KUCC North End ROD next year.

Please note that changes in the present reclamation plan for the Bingham Canyon Mine due to EPA actions will need to be reviewed and approved by DOGM and other appropriate state agencies prior to implementing these changes. (DJ)

New facilities constructed as part of KUCC's CERCLA remediation program will be evaluated on a case-by-case basis to ascertain applicability and appropriateness of various permits and approvals through the Remedial Design process (see Remedial Design Work Plan). KUCC will obtain all permits that are determined to be necessary.

2.0 GENERAL RECLAMATION STRATEGY

2.1 RECLAMATION TIMING

DOGM is in agreement with the flow chart for reclamation options described as Table 1. Facilities which may have a viable post-mine use in the future would be considered part of the current reclamation responsibility of KUCC, until that future time when those facilities have a confirmed and verifiable post-mine use. (AG)

KUCC agrees that a post closure use should be confirmed at closure for facilities to be left in place. The text and tables in the reclamation plan will be modified to clarify this point, while still presenting the most likely post-mining disposition of all facilities based upon current information.

2.2 SELECTION OF RECLAMATION ACTIONS - General Reclamation Strategy

2.2.1 CLOSURE ISSUES

DOGM agrees that in areas with overlapping boundaries, the later permit takes precedence for reclamation requirements of any new disturbance or new construction. Facilities permitted in 1978 which have remained unchanged, but are now in overlapping areas would be reclaimed as described in the original 1978 permit. DOGM will need to make a case by case determination of permit inclusion for facilities within overlapping permit areas. (AG)

KUCC agrees in principle with this approach. However, since the permits generally overlap in areas where only surface facilities are present, and because all permits require demolition of facilities without a post-mining use, in most cases the final disposition of the facilities will be the same no matter what permit they are assigned to.

Reclamation and decommissioning of monitoring wells and access to these wells will need to be addressed in the closure plan. **Please provide:**

- a list of the monitoring wells and a description of the reclamation and decommissioning to close out these wells; and
- a map of their locations and access routes. (DJ, AG)

KUCC will provide a map and table providing information on KUCC monitoring and production wells within the boundaries of permit M/035/002. Text will also be added describing the long-term disposition of these wells and well abandonment procedures.

2.2.2 POSSIBLE POST CLOSURE LAND USES

*The current closure plan identifies several possible post-mining land uses for different portions of the permit area without selecting one use. Post-mine land uses are typically identified at the beginning of operations rather than at the termination. Changes to the post mine land use are allowed, although some changes may also require changes in the reclamation plan. **Please identify** the most likely post mine land use for specific areas based on current information. (AG)*

Please provide:

- a map(s) identifying the areas for each proposed post mining land use. (LK)

The text will be modified so that for each area the most probable post-mining land use is identified based upon current information.

2.2.3 RECLAMATION STRATEGY

Please provide:

- a map(s) showing the specific reclamation treatments for all areas within the permit boundary. Show location and depth of topsoil replacement, and areas that will receive substitute topsoil and amendments (including type and rate of amendments) on this reclamation treatments map. **Please describe** seed mixes (including species and rates), seed bed preparations, and seeding methods to be used. **Please describe** revegetation success standards for all areas. Normally this is 70% of the vegetation ground cover that was assumed to be present prior to mining activities. (LK)

KUCC will provide a map of the waste rock disposal area showing the reclamation treatments planned for each location. A list of native species that are volunteering in the pit and on waste rock surfaces will be added to the reclamation plan. Any seed mixes that are used in the future will largely be based upon the native species that have already been observed colonizing nearby areas at a similar elevation and with similar slope aspect and soil chemistry. Within the areas to be revegetated, KUCC will insure that most physical and chemical barriers to native plant establishment are removed, and will apply a seed mix dominated by native species. KUCC intends to create healthy native habitat on these sites, however, KUCC does not intend to establish any formal revegetation success standards. If the revegetation effort fails in an area KUCC, will correct the physical or chemical cause of the failure if economically practicable.

2.2.4 DATA REQUIREMENTS

Please provide:

- *a larger version of drawing 451-T-3533 Mine Closure Plan for DOGM files. (AG)*

Please provide:

- *copies of the detailed maps identifying individual facilities for each plant as mentioned under section 1.2.2 Scope of Work, item 6 of the 2000 Addendum. (AG)*

A larger-scale version of drawing number 451-T-3533 will be provided in the revised plan. The scale of this map will be large enough to show the individual facilities within each area.

*The section describing cleanup standards mentions post closure sampling and characterization to confirm potential exposures and possibly direct the final closure alternative depending on sampling results. **Please describe** all proposed pre-reclamation characterization in the reclamation plan sections. (AG)*

Sampling to characterize potential soil contamination within and adjacent to facilities will be described in the revised plan.

2.3 RECLAMATION OF BUILDINGS AND STRUCTURES - General Reclamation Strategy

Each of the facilities in Table 2 with the entry of "Leave in Place" under the "Closure Approach" column will require a written justification explaining why each feature should be left to support the approved post mine land use. This justification will need to be reviewed by DOGM to determine if these features can be formally accepted as having a viable post-mine land use. (AG)

See comment response for Section 2.1.

Some of the surface facilities listed on Plate 3 from the 1998 Update do not appear on Table 2 of this submission. It is possible that some facilities have been grouped together for the Table 2 listing. **Please describe** the groupings used, or explain the absence of all features from Plate 3 on Table 2. (AG)

The facilities listed on tables and those shown on maps will be designated in a consistent manner.

The last paragraph of this section mentions that where necessary, fill material will be imported, drainages will be reconstructed, and the land surface will be graded and contoured. This general statement makes it difficult to assess the amount of reclamation work required to adequately reclaim these areas. Typical reclamation plans for large mine operations quantify volumes of fill material or topsoil, and describe the acreage to be graded. **Please describe** these reclamation tasks in quantitative terms or describe measures being taken by KUCC to quantify these reclamation tasks which will be performed "where necessary." (AG)

KUCC has committed to performing recontouring where needed to return the land surface to a natural contour as part of the facility demolition work. KUCC does not believe that volume estimates of fill and moved material are necessary given the generally conceptual nature of this plan.

3.0 MINE AREA

Underground block caving actions may result in slope stability problems within the pit and affect the integrity of the areas surrounding the pit. **Please describe** potential impacts of block caving on final closure of the pit. **Please describe** the projected acid generating potential (AGP) of the material to be encountered by the underground mining. (DJ).

At this time, KUCC currently has not made a determination to proceed with an underground mining operation. At present, this is only a potential option for the mine area. Until a determination is made to proceed with an underground project, KUCC believes that only a brief overview of the project's potential impacts is appropriate for the reclamation plan.

3.1 CLOSURE ISSUES - Mine Area

Please describe the minimum public access, if any, which must be maintained to the mine under the National Historic Site designation. Where does funding for long term maintenance of this public access come from? (AG)

KUCC will provide additional information on the National Historic Registry listing including any requirements the listing may have.

Please describe surface and ground water discharge from the Bingham permit area in a more detailed manner showing potential sources, discharge points, and treatment facilities. (TM)

Surface water discharge from the pit area will be described in more detail. There will not be any significant groundwater discharge from the pit area because KUCC intends to maintain radial groundwater flow towards the pit at all times.

Please describe the financial guarantees in place, if any, to cover the long term post-closure management of water discharge permits, groundwater monitoring, and maintenance of monitoring wells? (AG)

Kennecott provides for the long-term financial commitments, to include long-term post-closure management of water discharge permits, groundwater monitoring and maintenance of monitoring wells, through its internal closure reserves in accordance with U.S. Generally Accepted Accounting Principles (GAAP).

The plan in the 2000 Addendum states a "preferred alternative" is to allow the pit to flood to an undetermined level. According to the plan, the quality of the likely pit water will "not meet water quality standards acceptable for irrigation water, drinking water or discharge to surface waters, and also exceeds water quality standards for the principal aquifer in the southwestern Jordan and Tooele valleys." The Addendum further states "Allowing the pit to fill with water of this quality also may create an area of high pressure with water quality which is unacceptable for recharge into the aquifer."The high pressure head generated by the pit lake could also serve to move poor quality water near the east side leach and Dry Fork areas into the principal aquifer at a higher rate.

*Based on this information, the preferred alternative by DWQ and DOGM with respect to minimizing future effects on surrounding water quality and improving would be to keep the pit dewatered. Accordingly, **please provide:***

- *a table describing all of the flows in and around the mine (i.e. shafts, tunnels, wells, storm water, etc.) which includes the estimated flow and water quality of each source. In this table please include the ultimate disposition of the water, e.g. treatment or discharge, and assume that the pit will remain dry. Any possible effects on the tailings line and impoundment from all sources such as Dry Fork, the Jordan Valley remediation project and any other source of acid rock drainage must be evaluated and discussed. (DOGM, DWQ)*

There is not enough data currently available to select the optimum closure scenario for the pit. The ultimate closure scenario for the pit will be selected to optimize pit water quality, minimize potential negative impacts to surrounding groundwater quality and minimize negative impacts relating to perpetual dewatering. KUCC is considering both dry pit and pit lake options for the mine. The final option that is selected will be based upon the final pit geometry, wall rock geochemistry and hydrogeology. Whichever scenario is selected, KUCC intends to insure the following conditions are met at closure: 1) Radial groundwater flow into the pit must be maintained at all times. This can be attained with either a dry pit or a terminal pit lake; and 2) Minimize contact between pit water, groundwater and the pyrite halo. If a pit lake is allowed to form it will be maintained at an elevation that is below the pyrite halo on the ultimate pit walls. Text, tables and maps will be added to the reclamation plan to address these issues.

The plan states the local municipalities and water purveyors may ultimately assume costs of continued dewatering of the pit. From DOGM's point of view, KUCC would still retain reclamation responsibility for the pit and dewatering activity unless a permit transfer was approved. (DJ)

KUCC believes that it is appropriate to address this issue at the time, if ever, it becomes more likely.

Please provide:

- *information on acid base accounting (ABA) or geochemical studies for the pit walls and pit benches which KUCC has completed to date. **Please describe** any ongoing geochemical characterization of these pit features. (AG)*

Maps and tables summarizing the acid/base geochemistry of the open pit will be provided and ongoing studies will be summarized in the reclamation plan.

***Please describe** measures to manage surface drainage above and around the pit as part of the final reclamation of the pit area. Controlling surface drainage on the upper benches within the pit would also seem to be advantageous. (AG)*

KUCC agrees that controlling surface flows on the upper benches of the pit at closure will be advantageous. Text will be added to the revised plan that addresses this issue.

*Treating pit discharge water and pumping the effluent from this treatment to the expanded tailings impoundment or existing impoundment would be considered an amendment or revision to the current mine plans subject to review and approval by the DOGM. **Please provide:***

- *the appropriate submission to DOGM if these activities are proposed. (AG)*

Pit discharge water has always been routed through the Copperton concentrator and onto the tailings impoundment prior to being recycled back into the operations along with approximately 40,000 gpm of other waters. Some of the water in this process loop is discharged from the impoundment to the Great Salt Lake during the wetter months of the year. This discharge is regulated by DWQ under UPDES Permit No. UTD0000051 which imposes strict discharge limits on the quality of the water to be discharged.

Will additional funding be set aside to construct a facility that will process the predicted flow from the pit area when it becomes necessary? The present facility is designed to handle 1,200 gpm. The sizing of this facility does not take into account handling water recovered from the pit or the Dry Fork Plume (presently projected at 250 to 500 gpm) and any other water sources. (DJ)

At this time it is too early to determine the exact quantity and quality of post closure water management discharges that will report through the tailings impoundment prior to discharge to the Great Salt Lake. However, as part of the South Facilities Final Remedial Design, a Preliminary Post Closure Water Management Plan will be provided that will estimate the quantity, quality and routing of various post closure water flows. DOGM and DWQ are part of the Technical Review Committee for KUCC's CERCLA remediation program.

The post closure water treatment facility for all flows around the mine will likely be a lime treatment plant. Such a treatment plant will be designed to treat all acid plume water, waste rock contact water and pit water if needed. Depending on the optimum pit closure scenario chosen, it may take several decades after the cessation of mine operations before pit water needs to be treated, so it is too early to determine the size and location of an additional facility. By the time pit water is required to be treated there may be excess capacity in the previously mentioned lime treatment plant or other technologies will likely be developed that have not been identified at this time. Funding for any additional facilities, if needed, will be addressed consistent with KUCC reserve policy and US GAPP.

Please note that construction of a sedimentation pond or wetlands may also be subject to review and approval by DOGM depending on the specific details of these facilities. (AG)

The sedimentation pond referenced in the submittal was permitted and constructed as part of the Tailings Modernization Project approved by DOGM under permit M/035/015.

The closure plan gives a pump rate for the Dry Fork plume, however the final correction action for this plume is currently under review and has not been accepted. The necessary pump rate for containment of this plume has not yet been determined. - DWQ –

The text and tables will be amended to reflect the ongoing activities related to the Dry Fork corrective action plan. A fixed pumping rate will not be specified.

What evidence does KUCC have that the Dry Fork Dump extraction well provides containment of this plume? Where and how will the water pumped from this area be treated? (DJ)

There is geologic, hydrogeologic and sampling evidence that indicates the contamination beneath the Dry Fork area is contained. On-going investigations and monitoring are planned as part of the Corrective Action Plan to confirm this. These data will be detailed in the

Corrective Action Plan for the Dry Fork Area and will only be briefly summarized in the revised plan being discussed here.

Please describe the location and affected area for the proposed lime treatment for the Bingham Canyon Mine. How will the bonding for this facility be handled? The operational capacity of this lime treatment is described as 1,200 gpm. The projected flow from the Bingham Canyon area is 1,200 gpm without taking into account any other water sources. Pit pumping presently produces 1,200 to 2,000 gpm. The contact meteoric water is projected to be 1,200 gpm and there is an undocumented flow from the waste dumps referenced in your permit application The construction of a 1,200 gpm plant will not have any excess capacity for water from these additional sources. How will additional quantities of water be treated? Please describe how the disposal of the lime sludge from this facility on waste dumps will impact the quality of effluents emanating from this area. Please describe the final reclamation treatments for these lime sludge disposal areas. (DJ)

The location and exact acreage for the lime treatment facility has not yet been determined. However, it will be evaluated and presented as part of the Final Remedial Design mentioned previously. The bonding and permitting of the facility will be addressed through the same program as the intent is to use the facility for CERCLA remediation during operations as well as post closure water treatment. An evaluation of quantity and quality of lime sludges and disposal options will be presented in the aforementioned Preliminary Post Closure Water Management Plan as part of the RD process.

Water treatment, pumping, and discharge facilities associated with an underground mining operation would be subject to regulation and review by DOGM. Construction of a new water pipeline, lime treatment facility or sedimentation pond would need to be permitted as an amendment or revision to the appropriate KUCC permit. (AG)

Permitting issues associated with an underground mine will be addressed if and when authorization is received from Rio Tinto (KUCC's parent company) to proceed.

KUCC states that access to the pit perimeter "could be" restricted. DOGM Minerals Rules require posting of signs and control of public access to facilities which pose a threat to public safety. Please describe measures to mitigate the hazard to public safety around the perimeter of the open pit as part of final reclamation for this area. (DJ, AG)

Measures to mitigate the hazard to public safety around the pit will be specified in the plan.

A stability analysis of the pit walls may be requested by DOGM at a future time depending on the final reclamation details for the pit area. (AG)

KUCC agrees that depending upon the pit closure scenario that is ultimately selected, a stability analysis may be justified.

Where will the 40 acre sedimentation pond mentioned in the plan be located? Will this be of sufficient size to accommodate KUCC's estimated flows from all the waste streams presently projected to be directed to this pond? This facility will likely be subject to Ground Water Permitting requirements at the time of its construction. (DJ - DWQ)

The 40 acre sedimentation pond mentioned in the plan is located on the east side of the existing tailings impoundment and was permitted and approved by both DOGM and the DWQ as part of the Tailings Modernization Project.

The option of a solid waste repository for the pit area requires further evaluation. Although pit inflows could be controlled by peripheral pumping, additional facilities will need to be in place to treat water from precipitation events that collect in the bottom of the pit. (DJ)

If a solid waste repository is eventually planned in the pit, KUCC agrees that additional evaluation would be required.

*A facility for the treatment of water from the large Bingham Canyon reservoir is proposed to be built upon closure. **Please describe** where this facility will be built and the acreage required. **Please describe** where the effluent and waste by-products from this plant will be discharged (or disposed of) after the Copperton Concentrator has closed. (DJ)*

The current intent is to have one lime treatment facility that will treat all waters (see above responses). The location and footprint size of the facility and the final disposition of the effluent and waste by products have not yet been determined.

The Large Bingham Canyon reservoir (1600 acre ft capacity) has been scheduled to store waters from all sources prior to treatment. If a portion of the capacity is being utilized for this purpose, the projected flow of 1,669 acre feet from a 100 year storm event would cause this pond to overflow. Where will the excess solutions be stored prior to treatment? (DJ)

The termination of leach water applications to the waste rock disposal areas, the filling of Bingham Canyon with waste rock and continued mine dewatering have all lowered the amount of runoff that could be generated by a 100 year storm event. In particular, there is no longer any surface water flow in Bingham Canyon, the largest drainage basin contributing to the estimated peak flow. During a period of unusually high runoff excess water could also be stored in the Small Bingham Reservoir, the Large Reservoir Desilting Basin and in the bottom of the Bingham Pit (depending on the closure scenario selected).

3.2 POSSIBLE POST CLOSURE LAND USE - Mine Area

DOGM recognizes there are many possible post closure land uses of the mine area. Rather than comment on all the possibilities, we request that KUCC select the most likely post-mine land use scenario at this time, and provide information focusing on that scenario. The post-mine closure land use can be changed at a later time by submitting data which supports a different scenario. (AG)

The text of the revised plan will be changed so that the most likely post-mining land use scenario currently identified is listed. However, KUCC believes it is beneficial to continue listing the other less likely, but viable scenarios as well.

3.3 RECLAMATION STRATEGY - Mine Area

Please provide:

- *a tentative schedule of reclamation activities using the current prediction for the end of surface mining as the end of active operations. Although the Minerals Rules do not limit*

reclamation activities to a specific time period after active mining operations cease, it would be advisable for KUCC to schedule and complete as many reclamation tasks as possible during active operations. (AG)

KUCC will provide a general schedule of the reclamation activities in the revised plan.

Please describe monitoring and sampling activities which will be required for the mine area for an extended period of time after reclamation is complete for areas currently permitted with DOGM. (AG)

Text will be added describing long-term post-mining monitoring activities that may be required within the permit boundaries.

3.4 DATA REQUIREMENTS - Mine Area

Please describe the elevation and location where the Elton tunnel daylights outside of the pit and provide this location on the appropriate map(s). (AG)

It is unlikely that the Elton tunnel will be used to dewater the ultimate pit so very little additional information will be provided in the revised plan.

3.5 TENTATIVE RECLAMATION ACTIONS - Mine Area

Approximately 700 acres of the upper pit benches are identified as having acceptable soil geochemistry for revegetation. **Please provide**:

- justification for omitting these areas from revegetation treatments, or describe options for reseeding these areas, such as hydroseeding, aerial seeding, etc. (LK, AG)

Text will be added describing the reclamation treatments planned for selected areas with favorable chemistry on the upper benches of the pit. Explanations for omitting areas from any treatments will also be added.

4.0 MINE WASTE DISPOSAL AREA

DOGM believes clarification is warranted for statements in the 2000 Addendum under the waste and leach dump section. This section states that the current waste rock dumps are not subject to jurisdiction under the Utah Mined Land Reclamation Act (Act) because the disturbance was created prior to enactment of the law in 1977, and that there is no legal requirement for KUCC to reclaim the waste rock dumps. As clarification, it is true that disturbances created prior to the Act are not subject to the requirements of the Act provided these disturbances have not been impacted or utilized since that date. Features or disturbances in existence prior to the Act which have continued to be utilized are subject to the reclamation requirements under the Act. The reclamation requirements and performance standards take into consideration the nature and extent of the pre-Act disturbances and site conditions using baseline documentation.

Furthermore, the KUCC Mining and Reclamation Plan of 1976 states that no major revegetation is planned (for the waste dumps) because the waste material contains natural sulfide mineralization which becomes acidic when exposed to meteoric waters and the atmosphere. The 1976 Plan states after dumps become inactive for dumping, other steps will be implemented so that all dumps are left in a safe and stable condition. Techniques to accomplish this may include terracing and hydraulic methods. The 1976

Plan also states that if and when revegetation practices or methods are developed which would make vegetation economically practicable, such practices and methods will be employed on the dumps.

The 2000 Addendum mentions slides have occurred in the various areas of the dumps in the past and also makes the assumption that 10,000 cubic yards of material per year will require removal. This information demonstrates that additional measures are needed to leave the dumps in a safe and stable condition as described in the 1976 permit.

Given these clarifications and statements in the approved Mining and Reclamation Plan, the Division disagrees with the broad statement inferring that all waste rock dumps in their entirety are exempt from the Act. (AG, DJ)

KUCC agrees that in order to comply with the provisions of the 1976 Mining and Reclamation Plan some dump reclamation or stabilization activities may be needed. In particular those waste rock surfaces where revegetation is economically practicable should be revegetated, and the waste rock surfaces must be left in a safe and stable condition. The revised reclamation plan will address these issues.

4.1 CLOSURE ISSUES - Mine Waste Disposal Area

The preferred alternative stated in the plan does not provide for reclamation of the waste rock dumps, even though this is not protective of ground water in the area. The "recommended alternative action" discussed in the plan as slope reduction, reclamation and vegetation to minimize infiltration, will provide much greater protection of ground water. ***Please provide*** *the following:*

- *a list of the waste dumps which prioritizes their reclamation;*
- *a map of the dumps identifying each by name and using color coding and/or cross hatching to identify the estimated reclamation date and treatment. Please include the dump name and estimated date of reclamation;*
- *the rational for the dump prioritization in the text of the closure plan;*
- *the final estimated footprint of the regraded or reduced slope dumps; and*
- *a time-line with major milestone dates for dump reclamation. The time line should include the reclamation activities described in the plan and major time points in the mine operation such as the end of open pit mining, beginning of underground block caving, when such decisions may be made, and closure dates of the mine with/without underground mining.- DWQ –*

DOGM agrees that reduction of waste rock slopes is one method which could eliminate or greatly reduce stability hazards and also allow for surface treatments to reduce infiltration and leaching of meteoric waters. Reclamation of inactive dump areas should begin as soon as possible to distribute costs during active operations and take advantage of time. A measure not contemplated in this section is the construction of step-out or toe dumps adjacent to the existing dumps to improve stability, reduce slope angles, and break up continuous slopes. This would increase the disturbed area footprint and place waste dump materials beyond the cutoff wall system, but this would also increase the probability of revegetation success on the dump materials which could potentially reduce infiltration by meteoric waters. The long term structural and geochemical stability from this modification would outweigh the impact of the increased disturbance footprint, and greatly reduce the costs for perpetual water treatment. This modification and improved

revegetation success would also decrease the visual impact of the dumps and enhance the adjacent property values. ***Please provide:***

- *a plan for reduction and revegetation of waste dump slopes, or provide justification for other reclamation treatments. (AG)*

Reclamation treatments for the waste rock disposal areas will be described in the revised plan. These treatments will include revegetation to increase evapo-transpiration and reduce infiltration in areas with favorable waste rock chemistry, recontouring to reduce pooling and infiltration in other areas and slope stabilization in areas where slopes pose a risk of offsite contaminant transport. Explanations will also be provided for slopes where no stabilization efforts are necessary.

Please describe *the perpetual monitoring and maintenance of facilities to capture and/or treat water contacting the dumps in the final reclamation description for the mine waste area.*

KUCC will provide additional information and descriptions of the perpetual monitoring and maintenance of facilities capturing and treating water contacting the dumps.

Please describe *the funding in place for proposed long term maintenance and operation of the groundwater and surface water collection systems for the mine waste disposal area. (AG)*

See response to Section 3.1 above.

Mine waste areas examined during the 8/10/00 site inspection demonstrated that portions of the waste dumps will support vegetation using conventional revegetation techniques. **Please provide**:

- the characterization information currently available identifying dumps which may support vegetation;
- a written description and location map for those areas currently identified as having favorable revegetation soil chemistry. **Please describe** the soil characteristics and acreage for these areas. The Division encourages KUCC to continue efforts in characterizing the waste dump materials. (AG)

DOGM encourages KUCC to continue investigating the use of vegetation, chemical treatments, and runoff controls, as means to reduce costs for a perpetual water treatment facility. (AG)

DOGM encourages KUCC to continue mapping waste rock soil chemistry and identifying plant species which are volunteering on the dump surfaces. ***Please provide:***

- *the results of such information for use in determining appropriate reclamation treatments, if any, for waste rock dump areas. (AG)*

Text, tables and maps describing soil geochemistry and volunteer vegetation will be added to the revised plan. The reclamation treatments for the waste rock disposal areas will largely be determined by the limitations imposed by the waste rock soil chemistry.

Please describe *how the calcium sulfate sludge from stormwater treatment and the sludge from treatment of waste rock effluent treatment will be managed. Disposal of these materials within an existing mine permit area will require DOGM review and approval as an amendment or revision to the appropriate plan. (AG)*

It has not yet been determined how post-closure lime treatment sludges will be managed. Disposal options will be evaluated as part of the RD process after test sludges have been created for testing and evaluation.

The 2000 Addendum uses the terms natural and artificial leach water to refer to what is previously defined as contact water. Please clarify what the terms "natural and artificial leach water" refer to in relation to the waste rock, or use other defined terms such as meteoric contact water and applied leach water. Please be consistent with the terminology used. (AG)

The terms "meteoric contact water" and "leach water" will be used where appropriate.

4.4 DATA REQUIREMENTS - Mine Waste Disposal Area

Please provide:

- both a flow model and a water quality model to predict groundwater and surface water characteristics associated with the mine waste disposal areas. (TM)

A conceptual model of water and contaminant movements around the open pit and the waste rock disposal areas will be provided in the revised plan. A flow and contaminant transport model has recently been completed by the University of Utah. Reports associated with this modeling will be provided to both DWQ and DOGM.

4.5 TENTATIVE RECLAMATION ACTIONS - Mine Waste Disposal Area

Proposed reclamation of the waste areas requires review and approval by the Division, including the possible use of neutralizing materials and passivation products on the mine waste disposal areas. (DJ)

The revised plan will describe the neutralization agents that KUCC intends to use for reclamation. KUCC does not have plans to use any passivation products at this time.

A number of facilities under this category are described as being left in place for long term water management. **Please provide:**

- a description and justification for all mine facilities which are proposed to remain. DOGM will review this information and make a decision accepting or rejecting the proposed post-mine use. (AG)

See comment response for Section 2.1.

This section does not specifically state that all flat waste rock dump surfaces will be revegetated. DOGM will require that all flat dump surfaces receive the appropriate revegetation treatments to ensure revegetation success, unless KUCC can provide adequate justification for not revegetating these areas. (AG)

KUCC intends to revegetate those flat surfaces that have soil chemistry that is favorable for plant establishment. Flat surfaces that cannot support vegetation will be recontoured but will not be revegetated. Text will be added to the plan describing the planned revegetation treatments and providing justification for those surfaces that will not be revegetated.

This section does not describe concurrent or ongoing reclamation of waste rock dumps. DOGM would encourage concurrent reclamation of inactive waste rock dumps when possible to distribute the reclamation costs during active mining and provide the advantage of a longer time frame for establishment of vegetation. **Please describe** any concurrent reclamation taking place, or explain why this reclamation is not feasible. (AG)

The revised plan will contain text describing those reclamation activities that will be performed before closure.

5.0 EXCESS MINE WATER DISPOSAL AREA

5.1 COMPLETED RECLAMATION PROGRAM

The excess mine water disposal area was reclaimed in 1994 and 1995. These reclaimed areas have not been formally released by DOGM, therefore they would still be included as affected acreage for the Bingham Canyon large mine permit. Permit areas which are proposed for an alternate post-mining land use require Division review and approval. (AG)

KUCC intends to formally request release of these areas by DOGM in the near future. Until their formal release has been received, they will continue to be described in the reclamation plan.

5.2 POST CLOSURE LAND USE

The need to restrict the amount of water that can be applied to the excess water disposal area seems contradictory under an agricultural designation. Is this designation the best possible post-mine use considering this restriction? (DJ)

The need to restrict water application is compatible with an agricultural use as long as irrigation is prohibited.

6.0 ORE TRANSFER AREA - MINE TO PROCESS

6.4 DATA REQUIREMENTS - Ore Transfer Area - Mine to Process

The 1976 plan included a conveyor system from the mine area to the grinding plant near Copperton. Please explain why this submission does not describe such a conveyor system in the operations or reclamation sections, or modify this section to include the conveyor system. (AG)

Text will be added to the revised plan describing the conveyor system.

6.5 TENTATIVE RECLAMATION ACTIONS - Ore Transfer Area - Mine to Process

This section mentions that all sites except for those located on waste rock disposal areas will be regraded to conform with the surrounding land surfaces and natural drainages will be reestablished. **Please describe** all ore transfer areas and the proposed reclamation for these areas. (AG)

Text will be added to describe all ore transfer areas and the reclamation activities planned for these areas.

7.0 ORE PROCESSING FACILITIES

7.5 TENTATIVE RECLAMATION ACTIONS - Ore Processing Facilities - Mine to Process

This section of the submission assumes one half of the Bonneville facilities will have a viable post-mine land use. Please explain whether this is a general assumption, or if specific facilities have been identified as having a post mine land use. **Please describe** any specific facilities and infrastructure proposed to have a post-mine land use and provide justification for these uses. DOGM will need to review this information to determine if this proposed post-mine use is acceptable. (AG)

In the plan a general assumption has been made about a post-mining use for some of these facilities. See comment response for Section 2.1.

8.0 TAILINGS DISPOSAL

8.1 TAILINGS CLOSURE - Tailings Disposal

The use of the tailings impoundment as a repository for waste from a water treatment plant associated with the NRDC has the potential to change the characteristics of the tailings and impact the current reclamation plans. Please characterize the waste stream and the potential impacts of this waste stream on the reclamation of the tailings. (TM)

The characterization and testing of lime treatment sludges that will be placed in the repository will be evaluated as part of the RD process described above.

ACIDIFICATION POTENTIAL

On page two of this section, a statement is made that "Due to the presence of fine grained layers within the tailings, the depth of oxygen penetration is very limited, generally less than four to six feet. These layers will remain at or near saturation." Page four states that hydraulic conditions that will occur during closure will be "decreased water levels within the impoundment of approximately 33 feet." Will decreasing water levels increase oxygen penetration? Please explain what impact the dewatering effort will have if saturation is a necessary component for reducing oxygen penetration. (DJ)

The effects of dewatering on oxygen availability and acid generation within the tailings will be discussed in the revised plan.

8.2 SUMMARY OF EXISTING CLOSURE PLANS - Tailings Disposal

Recent developments associated with the proposed NRDC remediation describe directing the waste stream from water treatment plants to the tailings impoundment. The addition of this waste stream to the tailings impoundment may necessitate modification to the ongoing tailings characterization work and submission of an amendment or revision to the current tailings reclamation plan. (DJ)

Changes to the tailings stream into the tailings impoundment will require DOGM review and approval as an amendment or revision to the currently approved plan. (AG)

The characterization and testing of treatment sludges that will be deposited in the tailings impoundment will be evaluated as part of the RD process described above. DOGM and DWQ are part of the Technical Review Committee for KUCC's CERCLA remediation program and

as such will be kept informed of all studies regarding characterization and geochemical testing of the sludges and combined tailings flows.

9.0 EXCESS WATER MANAGEMENT AREA

9.5 TENTATIVE RECLAMATION ACTIONS - Excess Water Management Area

Please provide:

- a description and justification for all mine facilities under this heading which are proposed to remain unreclaimed for DOGM review. **Please describe** the plans for long-term management and maintenance of the facilities under this heading which are proposed for long term or perpetual use. (AG)

A brief summary of the facilities that are currently anticipated to have a post-closure use for water management will be provided in the revised plan along with a brief description of their projected use. See comment response for Section 2.1.

10.0 CERCLA SITES

Activities under the NRDC agreement which will affect operation or reclamation of facilities within the mine permit area will require DOGM review and approval. The perpetual use of mine facilities in connection with water treatment under the NRDC agreement would likely have an overlap in jurisdiction by DOGM and the other regulatory entities involved with the agreement. (AAG)

Comment noted.

11.0 FUTURE AND ON GOING RESEARCH IN SUPPORT OF CLOSURE

Please include an update on the reclamation research projects being done in support of mine closure in the annual report submitted to DOGM. (AG)

KUCC will begin providing updates on the reclamation projects and research being done in support of closure in the annual report submitted to DOGM.